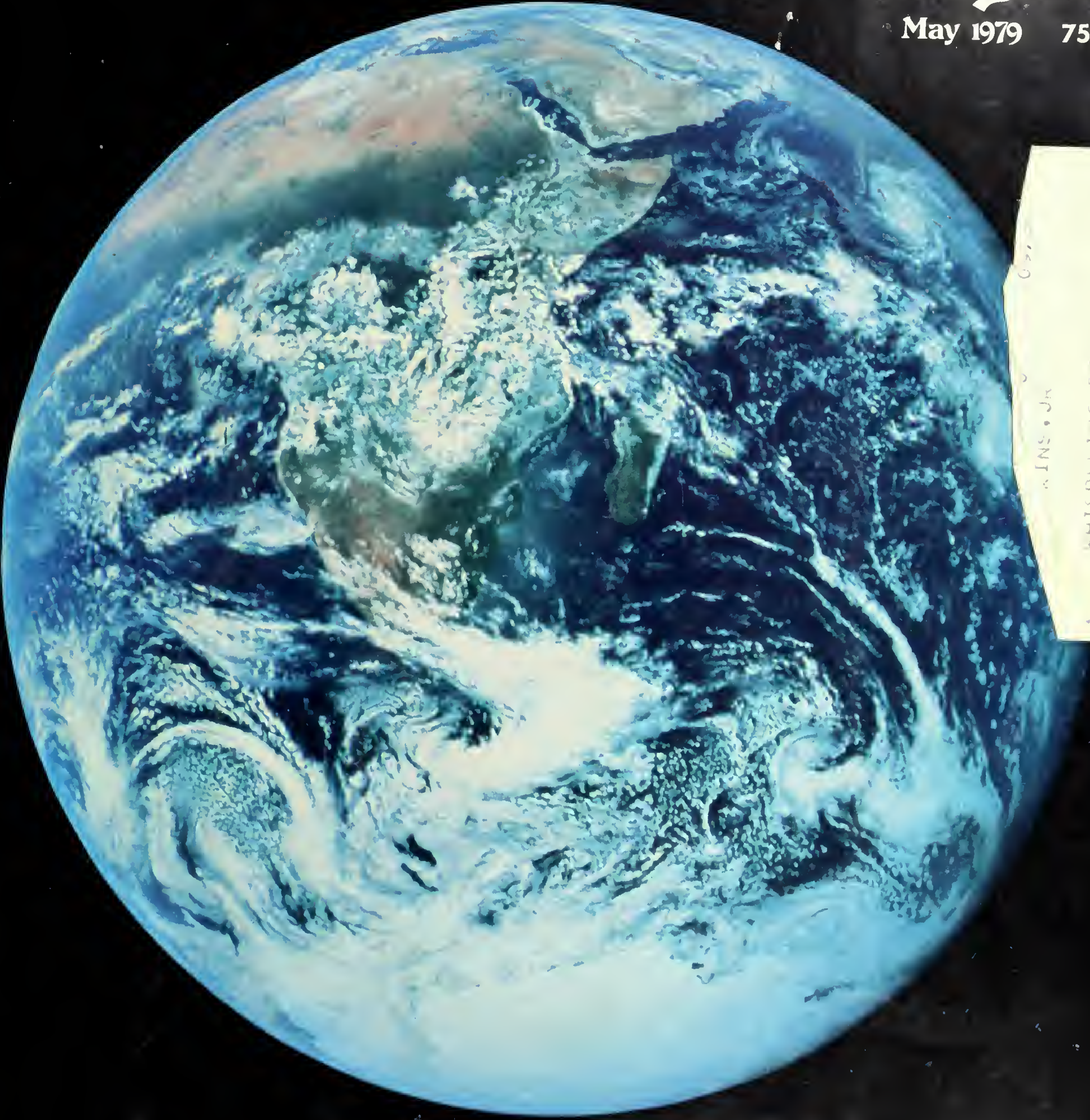
Outdoors in Georgia

May 1979 75¢



INS, JR
WHISPERING FORREST
LILBURN GA 30247

Outdoors in Georgia

Volume 9 May 1979 Number 5

FEATURES

Eugene Odum—
The Architect of Modern Ecology . . Lucy Justus 3

Catching the Early Bird . . . . . Steve Hudson 10

An Angling Legacy . . . . Liz Carmichael Jones 15

Predators of the Coastal Plain . . . . Trip Lamb 16

Stalking the Backyard Bear . . Kent Kammermeyer 21

Crop Damage and Deer . . . Daniel K. Grahl, Jr. 27

Focus: Georgia's Protected Species
Kirtland's Warbler . . Mary Anne Neville-Young 30
Lady's Slippers . . . . David Ettman 32

ABOUT THE COVER: In this month's issue, you'll find a powerful ecology message in "Eugene Odum—The Architect of Modern Ecology," page 3. We thought this cover properly set the stage for serious consideration of the earth and our relationship with it. Photo by NASA.

BACK COVER: From *A Sand County Almanac with other essays on conservation from Round River* by Aldo Leopold. Copyright© 1949, 1953, 1966, 1977 by Oxford University Press, Inc. Reprinted by permission.

Phone—656-5660

MAGAZINE STAFF

Mike Hartman . . . . . . Editor-in-Chief
Aaron Pass . . . . Editor
Susan K. Wood . . . Managing Editor
Lucy Justus . . . . Writer
Dick Davis . . . . Writer
Liz Carmichael Jones . . . Art Director
Michael Nunn . . . . Illustrator
Bob Busby . . . . Photo Editor
Edward Brock . . . . . . Photographer
Bill Bryant . . . . . . Photographer
Brenda Lauth . . . Circulation Manager

Outdoors in Georgia is the official monthly magazine of the **Georgia Department of Natural Resources**, published at the Department's offices, **Room 714, 270 Washington Street, Atlanta, Georgia 30334. Publication Number 217140.** No advertising accepted. Subscriptions are $5 for one year or $9 for three years. Gift subscriptions must be prepaid. Printed by Williams Printing Company, Atlanta, Georgia. Copyright 1979, **Outdoors in Georgia Magazine.** Contributions are welcome, but the editors assume no responsibility or liability for loss or damage of articles, photographs, or illustrations. Second-class postage paid at Atlanta, Georgia. 29,000 copies printed at an approximate cost of $15,000. **The Department of Natural Resources is an equal opportunity employer, and offers all persons the opportunity to compete and participate in each area of DNR employment regardless of race, color, sex, religion, national origin, age, handicap or other non-merit factors.**

Change of address: Please allow 8 weeks for address changes to become effective. Send old address as well as new address (old mailing label is preferred).

ISSN 0147—720X

George Busbee
Governor

Joe D. Tanner
Commissioner

BOARD OF NATURAL RESOURCES

J. Wimbric Walker
Chairman
McRae—8th District

Sam Cofer
Vice Chairman
St. Simons Island
Coastal District

Mary Bailey Izard
Secretary
Atlanta—5th District

Dolan E. Brown
Twin City—1st District

J. Leonard Eubanks
Pelham—2nd District

Alton Draughon
Pinehurst—3rd District

Linda S. Billingsley
Atlanta—4th District

Marvin Billups, Jr.
Atlanta—6th District

Lloyd L. Summer, Jr.
Rome—7th District

Donald J. Carter
Gainesville—9th District

Walter W. Eaves
Elberton—10th District

Leonard E. Foote
Waleska—State-at-Large

James H. Butler
Marietta—State-at-Large

A. Leo Lanman, Jr.
Roswell—State-at-Large

Wade H. Coleman
Valdosta—State-at-Large

DIVISION DIRECTORS

Parks, Recreation and Historic Sites Division
Henry D. Struble, Director

Game and Fish Division
Leon Kirkland, Director

Environmental Protection Division
J. Leonard Ledbetter, Director

Information Office
Mike Hartman, Director

Office of Administrative Services
James H. Pittman, Director

Coastal Resources Division
Robert J. Reimold, Director

Outdoors in Georgia To Cease Publication

Outdoors in Georgia magazine will cease publication with the June 1979 issue. This action has become necessary in order to continue the legally mandated programs of the Department of Natural Resources within a greatly reduced budget for next year. This action became final when the legislature approved the Governor's budget in March with no provision for additional funding for the magazine.

Since March we have been returning all new subscriptions, but this is the first opportunity we've had to notify you. For those of you whose subscriptions extend past June 1979, the Department will issue refund checks pro-rated against the number of months left in your subscription.

We want to thank you for reading our magazine and for the relationship we have enjoyed over the years. We have tried to bring you the very best magazine we could produce and we hope you've enjoyed it.

The editors and staff.

The Blueprint

Recently as I read one of H. L. Mencken's many derisive accounts of the "Scopes Monkey Trial" in Dayton, Tennessee, I became convinced that science may well be a scientist's second most important job. Indeed, the research and experimentation for which the scientist has years of specific training may be the easier portion of his life's work. The hard part may be convincing a stubborn, materialistic, and, yes, even ignorant world that what has been discovered is (1) true and (2) applicable.

In this issue we examine Dr. Eugene Odum, a scientist whose work may be fully as important as Darwin's. For as Darwin was the first to give us a comprehensive account of how things got the way they are, Odum has described how they work. For centuries there has been a vague understanding that living things interact with each other in a more-or-less harmonious relationship if left alone. This was recognized not only by scientists, but also by philosophers, poets, and even by common men who dealt on daily terms with nature. To describe this relationship by the traditional terms of habitat, food habits, reproduction would have been an immense task, which is probably why no one ever did it.

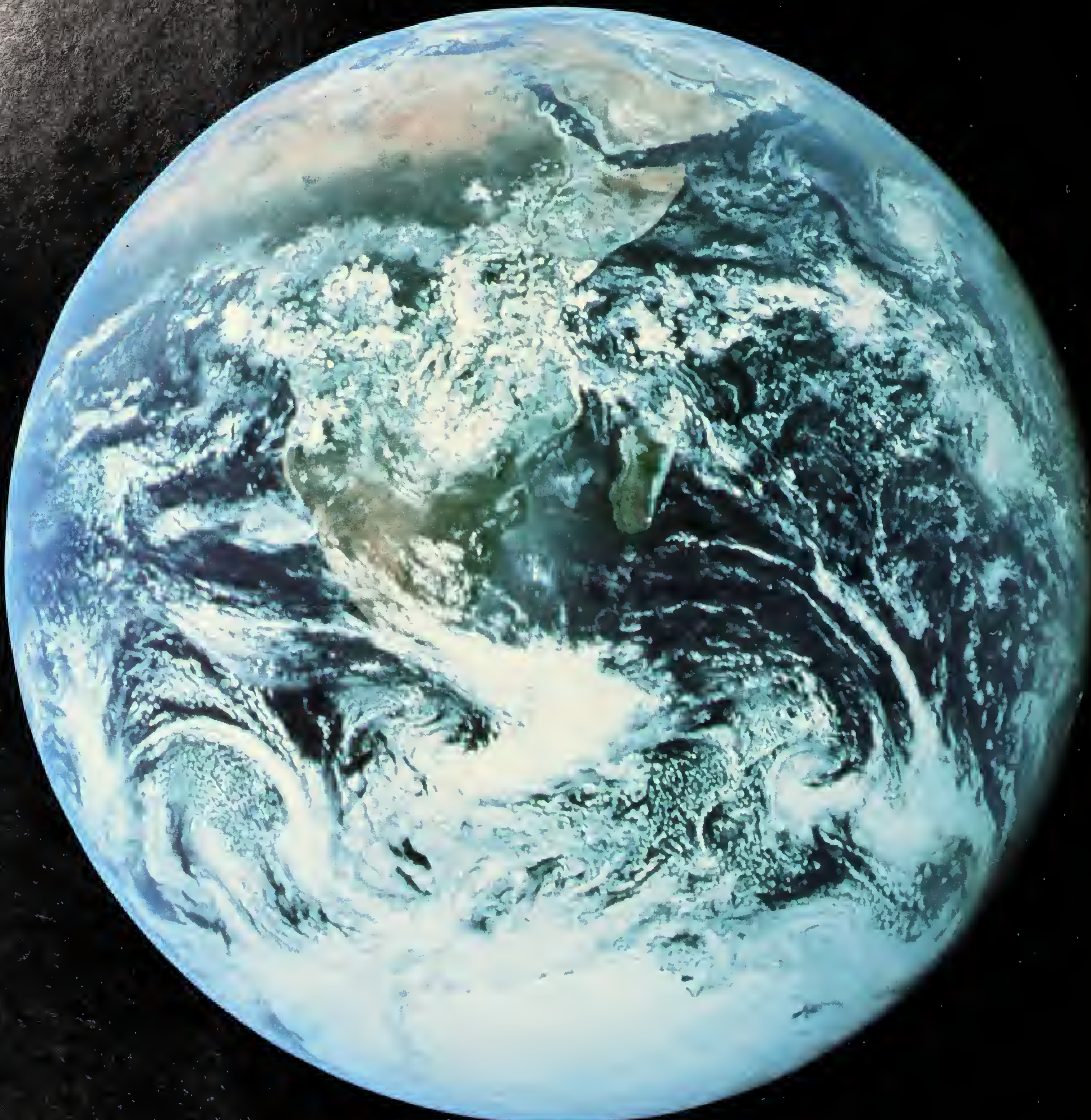
Odum did explain the relationships, but he avoided the tedious examination of everything under the sun. Instead, he went directly to the basic common currency of all living things — energy. His model, based on energy exchange, depicted in terms of energy gains and losses what we have always called the Balance of Nature and was a basic formula which could be applied to any system. He provided a blueprint for how the thing works.

Dr. Odum has never been hauled into court to defend the validity of his principle as was the teacher, Scopes, for teaching Darwin's theory, but neither has his work gone unchallenged. Basic validity has never been the point so much as specific applicability to existing environmental problems. Industrialists and corporate leaders who would give glowing testimonials to our famous Dr. Odum from any rostrum also hire platoons of lawyers to prevent the application of his principles to their business.

Legally proving the applicability of scientific principle to the real world of profit and loss *is* a drawn-out and tedious process which will go on for a long time. Let us hope that it will occur soon enough to prevent major problems. However, in the meantime we should thank Eugene Odum for providing the methodolgy.

Aaron J. Pass

By the way, what ever happened to the environmental thing?

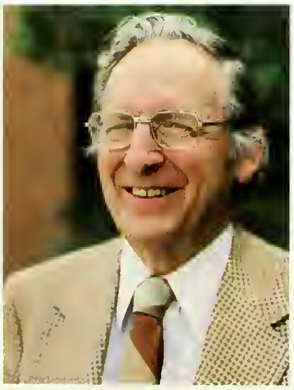


"This is
the environmental thing."

Dr. Eugene Odum

Eugene Odum
The Architect of Modern Ecology

By Lucy Justus



As we left the Institute of Ecology in Athens, I waited eagerly for photographer Bob Busby's reaction to the man he had just met. Earlier I had bet myself I could predict it.

"You know," Bob said, "he makes me ashamed of being a member of a society that's so wasteful."

Eugene P. Odum had done it again—as I had bet he would.

Beginning with a normally sensitive stranger, he had fascinated, charmed, and — gently, without preachiness or lecturing — touched something deep and responsive, evoking a feeling of concern and personal guilt.

Thousands of other people have responded similarly to the eloquence, wit and wisdom of the man very appropriately called "the father of modern ecology." Dr. Odum maintains that man and nature should be considered as a whole, not as a group of separate, unrelated parts, and that we need to act and manage resources on that basis. He pioneered the concept of holistic or ecosystem ecology as we know it.

Dr. Odum, in 1953, wrote the world's first ecology textbook. His *Fundamentals of Ecology* has been translated into many languages including Russian, Japanese, German and Portuguese and is now in the third edition. The book is still the definitive work on the subject. His writing also includes four other books, more than 250 scientific papers, and numerous essays and semi-popular articles.

Dr. Odum was among the first to use radioactive tracers in the study of food chains, and he and his brother Howard, also an eminent scientist, were among the first to recognize the importance of energy flow, not only as a principle of ecology but as a means of evaluating the useful work of nature. Dr. Odum's early research opened an entirely new frontier on the role of marshlands and established the fact that some marshlands are worth $50,000 or more an acre. His studies of migratory birds provided an understanding of the role of fat deposits as fuel for prolonged flights.

Dr. Odum established the Marine Institute on Sapelo Island and the Institute of Ecology, which he directs, at the University of Georgia. The institutes have attracted high-caliber staff and students, making the University internationally known in the field. Dr. Odum has twice been appointed to special chaired professorships, the Callaway Foundation Professor of Ecology and Alumni Foundation Distinguished Professor of Zoology. His regular schedule includes teaching, the supervision of graduate students, research and service, the service frequently taking the form of advice and assistance to governmental agencies. And he is an extraordinarily popular speaker who receives far more invitations than he can accept.

In all these roles, Dr. Odum has always been a strong and outspoken defendant of environmental quality. Long before the National Environmental Policy Act was passed, he urged that careful studies be made of channelization, clearcutting, strip mining, superfluous dams and the uncontrolled use of persistent pesticides. He was among the first to speak out against insidious development of beaches, marshes and river floodplains, and one of the first forceful advocates of population control and land use planning.

In confrontations with perpetrators of environmental degradation, Dr. Odum is an awesome opponent who uses wit as a surgeon uses a scalpel and facts as a Saxon might wield a battleaxe. But he strives for understanding rather than mindless surrender. Education, not only of students but decision-makers and the public as well, is, Dr. Odum emphasizes, the most important activity of his Institute. In 1975, the Institute began a series of workshops and short courses in basic environmental principles for professionals in governmental agencies. As a result of these classes, at least two federal agencies curtailed some of their environmentally disruptive activities. Dr. Odum hopes industry will soon follow suit.

Dr. Odum holds the two highest international awards in the environmental field, the Tyler Award, presented in 1977, and the 1976 Prix de l'Institute de la Vie. He donated the $150,000 which accompanied the Tyler Award to the University to start an endowment for the Institute of Ecology.

Professor, author, lecturer, internationally honored scientist, advisor to governments and recipient of two equivalents of the Nobel Prize, Dr. Eugene Pleasants Odum is a quiet-voiced, unpretentious man who occupies an undistinguished office, smaller than that of many secretaries.

He is a lanky blond with a quick smile, merry blue eyes, and a wide range of interests, a gentle person who decided long ago that, wherever else in the world he might go, he would not visit certain places where conditions were so bad he might lose his natural optimism about the future of man.

He talks fast, thinks faster and has little use for jargon or current catchwords, preferring the type of plain English that is readily understood. His conversation and formal presentations sparkle with humor, lively phraseology and — very frequently — startling statements intended to shock the listener into attention and reflection.

"Thank goodness for the energy crisis," Dr. Odum said recently. "Every day the energy cost creeps up, the better off we are going to be. It is going to make us come back to the real values of life and make choices based on human rather than materialistic values."

Always an opponent of uncontrolled growth, he reasons that if we are forced to reduce our fuel consumption, we will reduce our growth and, with it, our need for things which are currently destroying our life support system and reducing our quality of life. Additionally, he says, the economy will be more stable, our health will profit from the lowered pollution, and the less-consumptive lifestyle will prompt a return to more human values.

Growth, Dr. Odum says, is natural and desirable only up to a point. Then, according to the laws of nature, it must slow down and stop, in a city as it does in a person. If it does not, it becomes malignant, a "cancer" which consumes its host.

"If we continued to have cheap energy, we would overpopulate the world for sure because it would give everybody expectations that there are no limits," Dr. Odum said. "A society that thinks there's no limits will destroy itself with excesses of one sort or another."

In illustration, he uses "Calhoun's Nightmare," a study of rats confined in a finite space with abundant food and water. The overpopulated colony developed sexual perversions and other aberrant forms of behavior, eventually killing their own young and murdering each other. While people like to think themselves "more civilized" than Dr. Calhoun's rats, certain parallels can be drawn in overcrowded human populations.

"It is better for the organisms if there is not so much food," Dr. Odum said. "They don't waste it. They know, or at least respond to, their limitations in order to survive. They don't have so many young. They take care of the young they have. For man, too many artificial goods and services, which use up future resources, can prevent this natural slowdown from occurring. It's the old common sense of 'look before you leap.' All the ecology laws are reflected in the common sense that is part of our heritage. Everybody already knows all these things. We just don't practice them. We become temporarily blinded by the prospect of short term wealth which can be obtained by exploitation. A good energy crisis can wake us up to the fact that there is a tomorrow."

Then, stripping away the science and glamour, he condenses the seemingly complex and once-revolutionary concept of ecology into adages: Haste makes waste. Save for a rainy day. Don't put all your eggs into one basket. A stitch in time saves nine. . . .

And, although he doesn't mention it, there is one which says much about the man himself: "It's an ill wind that blows no good." While some people — usually those who want to do something atrocious to the environment — have depicted him as a prophet of doom, Eugene P. Odum is a confirmed optimist.

He finds hope not only in the energy crisis but in the financial problems of large cities. Our big cities, he says, will go broke, following the trend set recently by New York and Cleveland and, long ago, by other cities. But when this happens, he says, if we manage wisely, we will simply go back to smaller, lived-in cities where the taxes are lower and the quality of life higher.

"Growth always levels off, just as it does in your body," Dr. Odum said. "The smaller you are, the faster you grow, but the bigger you are, the slower you grow and soon you have to stop. Cities are the same way. They can't keep on growing. Yet the economic system is based on the fact that money is only made when you are growing. So it's a stupid system we have gotten into because we have always had a chance to grow, or thought we did."

The system, he observed, fails to recognize the fact that, after a point, growth leads not to economic gain but to economic chaos. Taxes paid by the average citizen finance growth — the streets, schools, sewers, water mains, police and fire protection for new suburbs, shopping centers and industrial complexes. As growth continues, this becomes an enormous burden, leading ultimately to a situation where only the rich get richer. The poor pay higher and higher taxes for fewer and more inefficient services — until they wake up. Then they either revolt and change the government or kill off the rich.

Studies, Dr. Odum says, have shown that when the size of a city doubles, the cost of maintenance and operation quadruples in what is known as the "inverse square law." After a city attains a population of 100,000-200,000, it acquires various kinds of environmental and social pollution which begin to erode the quality and cultural gains, and eventually the economic gains go down. Thus, the well-known "economies of scale" advantages of size are gradually replaced by "diseconomies of scale," or being too big to manage.

"People have been thinking if there are limits to our growth or limits to our size or limits to Atlanta, they would be physical limits — not enough water, not enough food, not enough space or something," he said. "But a book that came out recently, called *The Social Limits of Growth,* makes the point that those limits ultimately may be social, not physical.

"Most people would rather live in a city the size of Savannah or Macon than the size of Atlanta. But there is more money to be made in Atlanta so the economics drive you to accepting a lower and lower quality of life until finally you get mad and leave the city, which thousands of people do every day. They find a place somewhere else if they can, but thousands of them become trapped in the slums. Those who can't escape, commute and use the city as little as they can. The result is they don't go to the office if they can help it, they don't work very well and they eventually become concerned only with drowning their troubles in drugs or alcohol.

"When you get too many people crowded together, the system breaks down — self destructs. There is a thermodynamic law that says as you build up concentrated power and organization, there is an increasing tendency for it to break down under its own weight. You always have to recognize this and work hard to counter the tendency. The social and economic costs of doing so eventually become so high the city is no longer efficient and it disintegrates— just as cities have in the past. There have been no cities that haven't gone through these cycles of boom and bust, but people refuse to face this.

"Society is drugged or addicted to high energy consumption just like it is addicted to uppers," Dr. Odum observes. "It is addicted to a high rate of stimulation which inevitably has depression at the other end of it. In other words, after you get through with the big high you're going to have a big low. The boom and the bust are really frightening and it is dangerous because if you bust too hard you may not get out.

"People keep thinking the President is somebody who ought to get us out of this dilemma but it is not him. It's us. If President Carter really wants to do something about it, he really can't because big business will destroy him anytime they want to and see that a highly conservative president gets in. When people are scared, they vote for the person who says, 'I will keep it the same. I'm going to do nothing,' or 'I am going to return to the past where everything was nice and simple.' Changes have to be made at the people

Jimmy Valentine

level, so we can all face the changes and transitions that have to be made if we are to survive."

Will we change fast enough to avoid disaster?

"It's a race," Dr. Odum said. "Can we make it fast enough not to get caught some place? You can't change a system overnight. Young people thought in the early seventies if they fussed and protested we might make a sharp turn away from suicidal consumption and destruction of the environment, but you can't make a sharp turn when you are going 80 miles an hour. You have to slow down first.

"Most economists are predicting a pretty good worldwide slump in the next few years which could actually be a good thing, a sort of rest period where the countries will quit their mad pursuit of goals, both materialistic and militaristic, that are no longer attainable. Maybe it will make us look at and consider our environmental quality values and human quality values which we temporarily overlook or forget when we are obsessed with the pursuit of materialistic goods."

One thing we must change is our attitude toward energy.

Dr. Odum cites a recent study which challenges the theory that quality of life increases as energy consumption increases. "Up to 1955, adding to our energy consumption did seem to increase our quality," he said. "Our health got better, we got more more hospitals, more schools . . . . There is very definite evidence that in 1955 we were better off than we were in 1925, but we are not any better off in 1979 than we were in 1955.

"You just think. How are we better off? Our health is about the same. The average citizen does not get very good medical care. He's overweight, he's cancerous, he's breathing poison gases, and so on. In the U. S. we don't live any longer or any better than people in other countries that use less energy per capita. There is no advantage for a person to consume more energy than he is consuming right now. There might be some big advantages, and it might improve our quality of life, if we consumed less more efficiently.

"People are extremely resistant to any idea of being more efficient. And it costs a lot to change— to insulate your house and put a little solar energy in it. But people will begin to do it as soon as the price of fuel or electricity goes up.

"The price of natural gas is going to jump. Governments have held it down to a ridiculously low price in order to stimulate industrial use and growth. It is the highest quality energy source we have and the scarcest, so it is stupid to keep the price so low. It encourages people to waste it. If something is cheap, you do not respect it. You waste it.

"The period of cheap energy may be a very brief period in history. The Age of Petroleum is only about 50 years old and in that 50 years we have tripled the world population and increased our energy consumption 10 times. Human values have not improved that much. We don't have a 10-times better world, and there is no immediate substitute for oil and gas.

"Energy is the common denominator for man and nature. Man uses money. Nature's currency is energy. Man's currency really is energy. We just use money as a convenient exchange thing. This is something most people don't realize. The main reason we have inflation and will continue to have inflation throughout the world is because energy costs are going up.

"Our currency is being inflated in the sense that it costs more money to do a given amount of work. If you have a unit of energy capable of doing X amount of work and that energy cost a dollar last year and now costs two dollars, obviously you have inflation. Monkeying with the monetary adjustments, the things traditional economists do, is not going to do anything but sort of quick-fix it — postpone the inevitable time when you have to accomplish your work on half the amount of energy.

"I think many long-range, long thinking economists would agree that we are going to have to make some changes. We are going to have to be more efficient and we are going to have to use energy wisely. We have been saying this for years; but people don't do it because they don't see beyond today. Or maybe they have the fatalistic thought: 'I'm going to enjoy myself before the doomsday comes.'

"Energy is not recycled," Dr. Odum continued. "Energy cannot be recycled. That's a physical law. Therefore, you have to have new energy every minute. All the time. So energy becomes the limiting factor in everything.

"Energy problems will continue. We will never have it where we can just forget about it. To obtain enough energy and use it efficiently and get good work out of it and avoid disorder is a problem forever, and always has been.

"Man has always had a problem with energy — usually not enough food. Rome had its energy crisis, from which it never recovered, when it ran out of wood, the only source then known. Now we may have the same problem with oil. It's not something you cure like a disease and then forget. It's not a crisis; it's a continuing problem. It is a crisis only if we fail to recognize it as the foremost problem of our society. Energy is tied in with everything else — social values, environmental values, pollution . . . ."

Dr. Odum smiles somewhat sadly about reporters who come to discuss energy with him and, in leaving, casually ask, "By the way, what ever happened to the environmental thing?" "This," he tells them, "*is* the environmental thing." Dr. Odum's philosophy is based on the theory that everything is the environmental thing. Everything is one thing — with many parts. And those parts encompass a

diversity that extends from water, air and rocks through economics, sociology and politics.

"At the moment, our problems with the environment are not technological, biological or scientific," he said. "Eighty percent of them are political, economic and social. Therefore, we as ecologists must get into that aspect just as much as we get into the scientific aspect." One of Dr. Odum's primary interests on the academic level is developing an integrative synthesis of social and natural sciences.

And, just for the record: close to 20 years ago, as part of "the environmental thing," Dr. Odum was preaching the conservation of fossil fuels to postpone the inevitable shortage. He predicted that we would eventually use up our fossil fuels and observed that if we built smaller cars and drove them slower, the supply would last much longer. The energy situation is one to which he applies the adage: Haste makes waste.

What should we do now?

"The wealth we still have ought to be used to design for the future instead of bleed the past," Dr. Odum said. "While we still have oil and coal, and energy is relatively cheap, we should be using it to prepare for new technology, new ways of doing it. We are not going back to the caves and we can't go back to Jeffersonian agrarian times. The population is too large. Maybe we will use less energy, as we once did, but we will use it in a different way and a better way and as far as anybody can see, it will not have to be doomsday."

But he cautions against complacency. "Too often the rationale is that any resource you run out of, technology will find a substitute for," he said. "That holds good for many resources. We do find substitutes. But there are some basic things for which there are no substitutes as far as anybody knows. There are no substitutes for energy or water or human values. Man does not and cannot create any vital resource whatsoever. All he can do is find resources and use them wisely."

It is a mistake, he says, to think blithely that before fossil fuels are gone, atomic energy will have become a panacea. Presently, atomic energy is uncertain as to its effects and too expensive to be feasible on a large scale. According to Odum's Law, which Dr. Howard Odum, Eugene's brother, promulgated, it requires energy to produce energy and it is the net result, or net energy, that counts. Currently, there is a question as to how much net there is in atomic energy. A lot of fossil fuels are required for mining, processing and enriching uranium to produce electricity from atomic fission. Without oil and coal, very little electricity could be made from atomic energy alone. Dr. Odum believes there is a good future for atomic energy, but he points out that it could prove socially unacceptable for health or other reasons.

We must also recognize the difference between quality and quantity, Dr. Odum says. We have available an enormous quantity of solar energy, for instance, but converting it to high quality forms for efficient use is the problem.

Although the shortage of fossil fuel is the current newsmaker, it is only one of many environmental problems we should be considering, Dr. Odum says. Others include water, food and open space.

The South will continue to grow for a few more years, Dr. Odum said. "Business will come down here because it's a little cheaper. The southerner is eager for work so the level of wages is somewhat lower, and we are not yet quite as fussy about waste as more populous regions are. Unless we have some changes of public opinion, we could grow willy-nilly, without any plans, until pollution and other problems reach the same levels as in regions which are now in economic decline. It is important that the southern tradition of love and respect for the outdoors be continued and reinforced legally and by public opinion."

Dr. Odum would like to see about one-third of the land in the South set aside as life support buffers in and around developed areas. And, he says, we should select with great care the industries we do accept. For small towns, several small industries, with little automation and many jobs for unskilled workers would be preferable to, say, an oil refinery. Refineries, he contends, are highly automated, employing relatively few people, and most of the money goes to residents of other states. Without careful planning, the South could end up with something similar to the Boston-Washington strip city which Dr. Odum believes will rapidly evolve into an overgrown, crime-ridden, uneconomical monstrosity from which people flee to the virgin country of the sunbelt. "We should keep our southern cities separated by greenbelts of natural and agricultural land and as a hedge against too much development," he said.

Obviously, our most basic environmental problem is the potential destruction of our life support system. "The difficulty," Dr. Odum says, "is that the market system does not recognize any value unless there is an end product, so the true value of many, many natural areas is undervalued or underpriced in the system, and man-made things like shopping centers are overvalued. We fuss with the economists a lot about that and they admit that in resource allocation there's a 'market failure.' They are busy trying to devise means of doing something about that. One means of doing it is to take these things out of the market place, to say 'This is not for sale because it is necessary for public survival.' Another thing would be to restrict the use. A property owner's right does not include and never has, the right to destroy the property or cause injury to others, as we do by polluting streams. People forget that our laws are founded on British principles which hold that ownership of property is a stewardship, not a license to destroy.

Jimmy Valentine

"If you propose to do away with valuable natural resources — to replace them with something artificial — the burden of proof ought to be on you. You should have to show that there is a long-term public benefit to making the change, and if you can't, then the change should not be made.

"Of course, you run into the unresolved things which are chronic to our society, such as long-run versus short-run values. Future generations aren't here to bid on the property so the values are usually determined by what you can get out of it right now. Take the Chattahoochee River. The future value of that water is going to be extremely high. Atlanta will depend on it. But right now, the value of developing the land upstream, or polluting the water, or doing other things is much higher than preserving it for future generations. It is almost impossible to preserve anything for the future unless public opinion gets very strong. Encouraging things do happen when public opinion becomes strong. In 1968, the people of Georgia decided, through legislative action, that coastal marshes are more valuable in their natural state than in a developed state."

Dr. Odum says that 90 percent of the value of natural resources is not included in our present pricing system. And, for several years, one of his major interests has been an effort to change that system. Currently, he is working to determine the value of wetlands which, in addition to recognized local values, also have a global value through the role they play in atmospheric and hydrological cycles. Some wetlands, however, may have little value. But, as always, Dr. Odum's thought is: Let's find out if it is worth anything, and if so, how much, before we pave it over. "What good is it going to do us to be rich," he asks, "if we end up with chronic respiratory diseases and all these other things that come from damaging our life-support systems?"

It's an interesting question. Dr. Eugene P. Odum is given to posing interesting questions. ●

Catching the early bird

By Steve Hudson
Photos by the Author

It is early morning. In the east the sun still sleeps behind hills and mist, but here a line of figures appears, a purposeful caravan moving slowly over the still-darkened terrain. They carry an odd cargo—some chairs and a table, a nearly invisible net, some books, a briefcase, and a cage and a mouse. Now they stop. Chairs squeak softly as they are unfolded, and a rustle marks the rousing of a rabbit as one dim figure moves through undergrowth to prepare the nets. Another bends to ready the table, setting it with books, a case of metal rings, and an odd assortment of rulers and scales. The cage, now holding one somewhat puzzled mouse, is anchored under a nearby tree, and the preparations are complete. The dawn-dwellers return to the chairs and settle like sentinels, quiet but alert, to wait for the sun and the activity it will bring.

But their wait will not be long, for they have prepared well. They are bird banders, and this day they will catch the early bird.

For thousands of years, even back to the time of royal hawks and Roman empires, people have been marking birds for purposes of identification. But bird banding as we know it did not develop until the end of the nineteenth century when Hans Mortensen, a Danish schoolteacher and amateur ornithologist, began to tag birds as part of his studies. Soon his rings, as he called them, started turning up all over Europe, and banding's popularity began to grow. It took on increasing scientific importance, too, and today it is recognized as a valuable tool for effective wildlife management.

Modern bands—small, numbered aluminum ringlets ranging from tiny versions barely two millimeters across to giants too big to fit your finger—are supplied to licensed bird banders by the U.S. Fish and Wildlife Service. The banders, who must become thoroughly qualified to handle and identify birds before they ever receive banding permits, then put the bands to work.

This year they will band over one million birds in the United States alone. Perhaps 200,000 of those bands will ultimately make their way back to the National Bird Banding Laboratory in Laurel, Maryland where the information that they provide is put to use. For example, if banding data show that the populations of doves, a commonly banded Georgia species, are growing, upcoming dove seasons can be extended without harming the species' population. On the other hand, if it shows that dove numbers are declining below certain levels, seasons might be cut by a few days to insure good hunting in the future.

Certainly bands can shed light on overall population trends. But they can reveal individual surprises, too. Ducks banded in New Mexico have found their way to Japan, and terns banded near the Arctic Circle turned up near Antarctica—a roundtrip

Here Don and Doris Cohrs busy themselves with banding. Below, an immature male Baltimore oriole finds itself caught in the net; it will be gently removed, measured, weighed and banded like the yellow-breasted chat on the opposite page.

journey of over 25,000 miles. And the blackbird singing in that wrinkled old oak may be completing a southbound journey that he started in New York. He may have been practicing that same song for over 14 years.

You never know what will turn up. But first, of course, you've got to have birds.

The sun rises with a burst of light and a clatter of beaks. Already the songbirds are moving, and that racket by the briar bushes says that one of them is caught there in one of the nets.

Rising, the bander goes swiftly to that net to bring back the bird. He moves quickly, lest the heat of the sun or a predator's jaws claim it before him. Now he sees it—an oriole, its orange feathers blazing against the gray-green of morning. Gently he untangles it from the loosely-strung, almost invisible mesh. As he works, another bird (this one a cardinal) flies headlong into the net, too, and suddenly birds are everywhere.

His assistants move to help separate birds from nets and to take them in soft cloth bags to the banding table. There the bander carefully studies each one—weighing it, measuring it, sometimes even looking at the inside of its bill or at its feet. He records his observations in a ledger next to a number; then he grasps the correspondingly numbered band with a special set of pliers and ever so gently clasps it about the bird's lower leg. Now tossing the bird lightly into the air, he watches as it flies to a nearby branch. There it pauses . . . wondering, perhaps, what those odd creatures without feathers are up to now. But it seems to resolve the matter to its satisfaction, and in a moment it is gone.

Suddenly all of the birds are gone. Looking skyward, the banders see why: a hawk is dropping toward a target. The small birds have vanished lest it be one of them, but the hawk is intent only on the caged mouse set out by the banders themselves. Landing on the wire enclosure, he eyes the free meal and tries to find a way to get to it. Too late he notes the banders approaching. He tries to fly, but can't; his feet have become entangled in the loops of nylon fishing line that cover the trap's exterior. Now (and carefully, for he has dealt with talons before) the bander frees the hawk and deferentially bands it, too.

Soon the songbirds return. Now and then a previously-banded bird is captured again; one particularly persistent fellow is caught three times within an hour. Another, apparently wanting to get

(Opposite page) Measuring and other information gathering are what make bird banding such an important activity. (This page) A male cardinal being banded.

in on a good thing, flies into the net, bounces off and regroups, and makes a running leap into it again. Persistence like that should surely be rewarded, and at last he, too, gets his band.

And there are hazards. The small birds are generally harmless, but they are not above a little biological warfare. Almost to the bird, they choose the very moment they are picked up to relieve themselves, but the banders are used to such things. They are devoted, and after all, this *is* science.

So the day continues. If ducks are on the agenda, the banders wll use funnel traps—wire cages with funnel-shaped entrances that birds enter freely but for some reason cannot leave. For other varieties they may use ordinary spring-door traps, and occasionally they must band young birds in the nest.

In any case the work that they do is unique in its importance to both the birds and the biosphere as a whole. As they watch the ebb and flow of avian populations, they indirectly monitor the quality of the planet's lifezones, too. ●

Steve Hudson is a freelance writer and graduate student at the University of Georgia.

If You Find A Band

With an increasing number of birds being banded each year,the likelihood of finding one grows. Should you find a band, carefully straighten it out and return it to the Bird Banding Laboratory; U.S. Fish and Wildlife Service; Laurel, Maryland 20811. With it, send the following information:

- your name and address, legibly printed
- when and how you found the banded bird
- all numbers and letters that appear on the band
- the location, as accurately as possible, where you found the bird.

If the bird is alive, DO NOT try to remove the band. That requires special tools. Instead, write down the band's number and release the bird. Shortly thereafter you will receive a Certificate of Appreciation from the Bird Banding Laboratory along with a brief history of that bird as told by the banding data. Its bander will hear of the discovery, too, and a little more information will go into the computer.

If you would like to participate in banding programs yourself, you will need to be licensed by the Fish and Wildlife Service. Before a license is issued, the prospective bander must have three experts vouch for his abilities at banding and identification. "You need to be thoroughly familiar with birds," says Don Cohrs, an active Georgia bander, and he explains that one of the best ways to gain the needed skills is to apprentice yourself to an experienced bander.

Don and his wife Doris, both bird banders of some note, are glad to help train new banders. If you are interested, contact them at 2446 Jefferson Terrace; East Point, Georgia 30344.

An Angling Legacy

By Liz Carmichael Jones
Art by the Author

This is a story for my mother. "My Mother the Fisherman," I guess it should be called. I only wish she was here to read it, but, you see, she died over a year ago. Several months before that, though, I had told her I was going to write a story about her and her love for cane pole fishing for "Outdoors in Georgia." She laughed and said she didn't think that would be much of a story. Maybe it's not much of a story, but it's a promise fulfilled.

I guess my mother was typical of many Georgia fisherman who have developed a real philosophy about fishing. You don't have to have all that high-priced paraphernalia in order to go fishing, she'd say. A cane pole would do fine.

I was "down home" the other day visiting my father and happened to glance out the windows and glimpsed her fishing pole propped against the big oak tree by the wood pile. I'm sure no one has touched it since the last time she used it. A flood of memories came rushing back.

"Fishing," my mother once told me, "is the greatest therapy in the world. No matter how many problems and worries one has, they seem to disappear while fishing. It is the best way to relax. You should try it. You're too nervous. It would do you a wealth of good."

"Well, I just don't have the patience, Mama. I don't think I could just sit there for hours holding a pole waiting for a fish to bite. I just have to have more to keep my attention," I replied.

"No, there's plenty to do when you fish. You have time to commune with nature, enjoy the outdoors and time to think. It's a quiet time and you can think such beautiful thoughts amid all this solitude. You really should try it," she said.

On past the wood pile is my mother's fish pond on the backside of the property. Daddy doesn't fish so it can't be called his fish pond. Anyhow, he built it for her. She didn't drive a car, so for years Daddy spent hours taking Mama places to fish. He never complained about the going and coming of fishing trips, but I guess they finally concluded it was more convenient for her to have her own pond.

I remember how excited she was when the pond was completed and the Game and Fish people came to stock it for her. This was many years before I started to work with Natural Resources and I suppose the first time I ever heard about the Game and Fish Department. I was truly suprised to learn that this stocking was free of charge. So, when I began my employ with DNR, this stocking program was about the extent of my knowledge of fishing programs. I knew that these people had made my mother and untold numbers of her fishing buddies very happy.

Mama liked sharing her fishing place. Children from all over town would come and fish with her; most of them were, or had been, her students. I will never forget one Christmas when a student of hers gave her a can of worms all tied up with a big red ribbon. On Christmas Day, after she had opened all her fine and expensive gifts from family and friends, she smiled and said what a wonderful Christmas it was and so many beautiful presents she had received, but she thought the best gift of all was from that little boy who gave her a can of worms for fishing!

Having her own pond did not confine her fishing to this one spot for long. She still enjoyed fishing other places and usually knew where the fish were biting best in all the ponds in Butts County. Of course, Jackson Lake was close by and eventually my father started making those fishing jaunts again, taking mama to the lake. But he solved this problem, too. He bought a cabin on Jackson Lake so they could go and spend the night and Mama could get up at 4 a.m. or 5 a.m. or anytime she wanted to, and he could sleep.

She could swap fishing stories with the best of the regulars. She could discuss the best kind of bait at length with anyone knowledgeable about this subject. She had her own worm bed that was as good as anybody's, she said. We never doubted her knowledge about fishing or her deep devotion to this sport. I don't think I've ever known anyone to enjoy a hobby as much as Mama did cane pole fishing.

Some day soon I'm going home again and put that lonesome cane pole propped by the wood pile to use once more. And I hope the magic she found in fishing will cast its calming and happy spell on me. She would like that, I know she would. ●

Predators of the Coastal Plain

By Trip Lamb
Photos by the Author

I suppose I should confess falling victim to dime-store fiction, an amalgam of truth and fantasy that captures the best of us in those impressionable years. Jungle novels, where heroes were pitted against formidable foes of nature, received utmost priority. Of all the fictional adversaries, however, carnivorous plants were the ultimate nightmare. What a horrid fate to be nabbed by the very bush behind which you were hiding. More recently I was truly delighted to discover that such plants actually exist—even more so to learn that most of them restrict their diet to insects and the like.

Not only are these plants found in faraway places (as the more vivid imaginations rightfully dictate), but many species occur within our state. With four genera and over twenty species inhabiting the coastal plain plus other species existing in other parts of the state, Georgia is richly endowed with these extraordinary wildflowers. But why, you may ask, should plants, whose placid food-gaining processes via photosynthesis depict ultimate autonomy, resort to preying upon other organisms? To find the answer we must backtrack briefly and examine a portion of plant history.

Over millions of years, new species of plants arose to invade certain habitats previously unsuitable for plant life; such areas invariably lacked one or more of the basic requirements associated with proper plant growth. The carnivorous plants of North America chose lowland bogs and swamps where necessary minerals such as nitrogen were in very short supply. Occupants of acid soils, these plants trap and digest small prey organisms to supply substances otherwise absent in their characteristic habitat. Thus equipped with peculiar predator mechanisms, the carnivorous plants are among the most impressive products of botanical evolution.

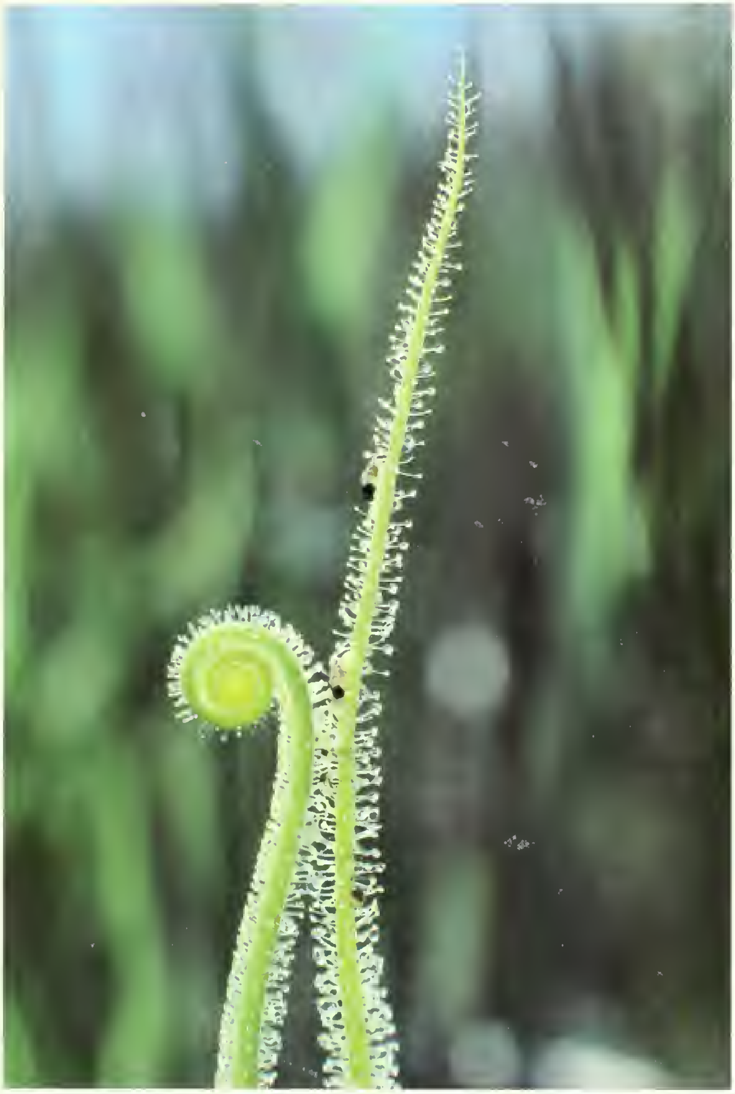
At a glance the butterworts appear to be just another one of many innocuous wildflowers inhabiting pine savannas and bogs. Each spring their tall stems, bearing solitary flowers, arise from a clump of basal leaves. Nothing about the plant alludes to its carnivorous habits. Upon closer inspection, however, each leaf surface reveals hundreds of macroscopic glands, many of which exude a glue-like substance; others secrete digestive enzymes. With these inconspicuous attributes, the butterwort leaf functions as a piece of living flypaper. Should a tiny insect attempt to scurry across a leaf, it soon mires down, hopelessly adhering to the sticky surface. Soon the plant's digestive glands come into play. Caustic enzymes convert the insect proteins into more fundamental components. With digestion complete, the plant readily absorbs necessary

Large stands, like this one, of the pitcher plant Sarracenia leocoplylla *are becoming increasingly rare.*

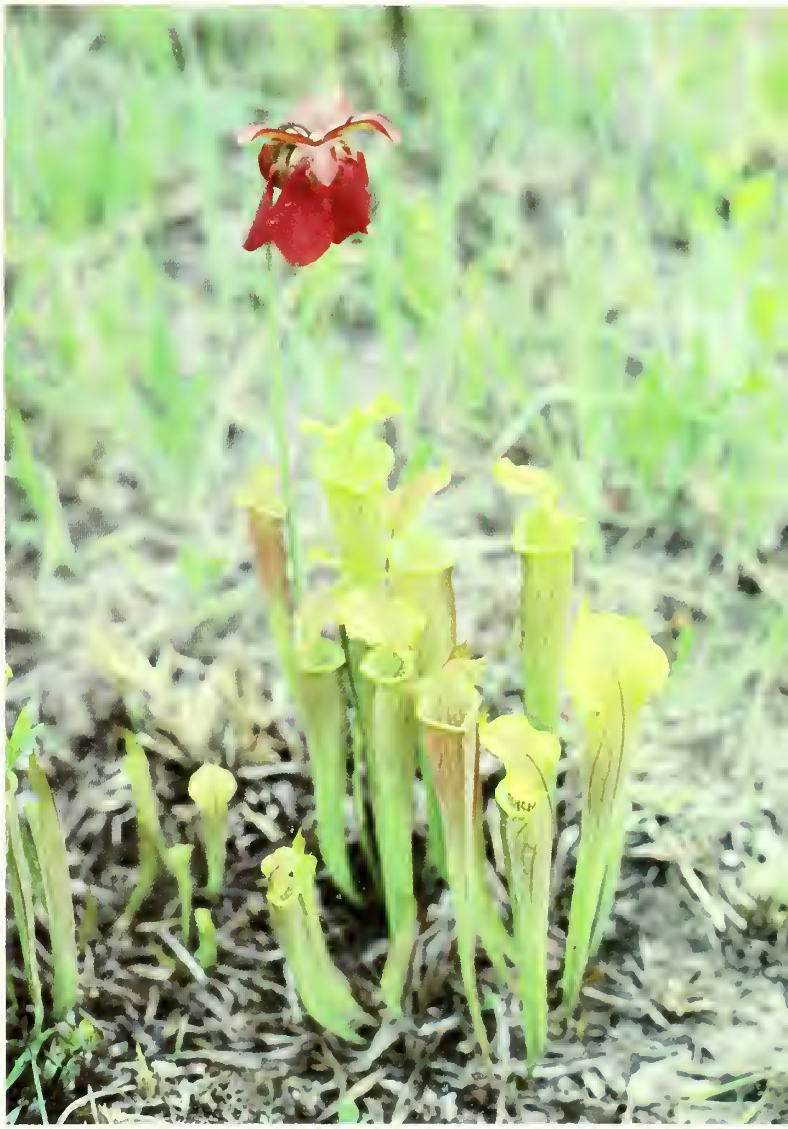
minerals. These raw substances will be incorporated into plant proteins at a later date. All that remains of the unfortunate victim is a withered exoskeleton—a stark warning to future trespassers.

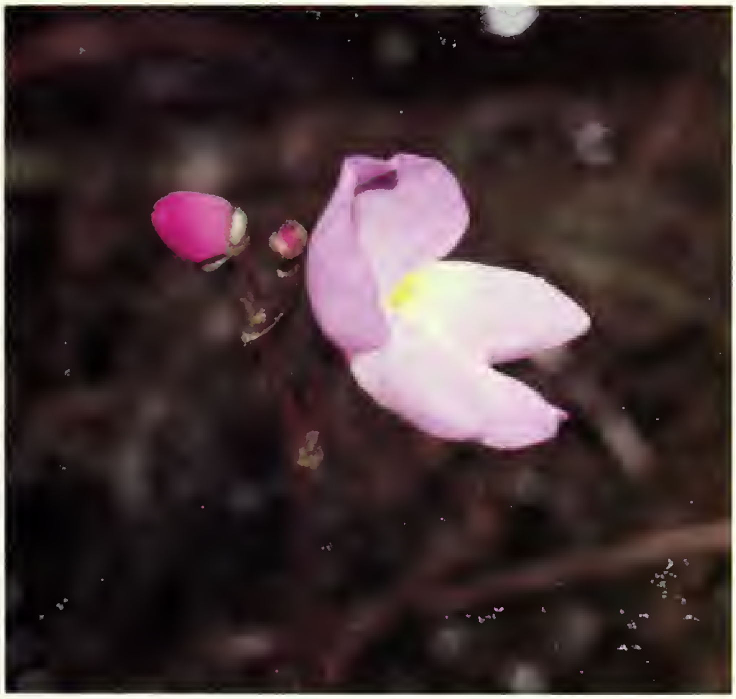
The sundews surely stole the butterworts' patent for snaring bugs, for their strategy is remarkably similar. The sundews, however, have employed some elaborate improvisations to make their traps more effective. Rather than minuscule glands, sundews bear large stalked ones resembling tentacles. Topped with a clear viscous fluid, each gland appears laden with dew, hence the plant's common name. Drawn to nectar secretions, insects light upon the glistening leaves. Smaller organisms are held fast by the leaves' adhesive surface. Slowly, adjacent tentacles descend upon the struggling prey to insure the plant's hold. A few days later, the quarries' resources depleted, the stalked glands assume their original position. Remarkably, sundews show a bit of discretion, for if a small rock or twig is placed on a leaf, the plant soon recognizes such objects as inedible and releases its hold. These enigmatic mechanisms aroused the curiosity of the eminent naturalist Charles Darwin. He spent years studying the sundews and their carnivorous associates. Darwin's findings were published in one of his less controversial works entitled *Insectivorous Plants.*

Despite their relative abundance, the diminutive bladderworts often go undetected in the wild. Many species lead an aquatic mode of life, favoring quiet ponds and swamps. During summer months, the delicate blossoms emerge from their watery abode, producing a spectacular display. On tranquil mornings the tiny flowers are difficult to distinguish from their flawless reflections. Beneath the water's surface lies the bulk of the plant. Rootless stems bifurcate into smaller branches, which terminate in countless specialized leaves, or "bladders". Only a tenth of an inch in diameter, these structures comprise the business portion of the bladderwort. Each is a miniature spring trap of complex design and proficient performance. The oval vessels are fluid-filled with a unique trap door on the distal end. Sensitive hair-like structures surrounding the door serve to trigger the trap. For potential prey items, inadvertent contact with the trigger hairs beckons disaster. Once tripped, the door suddenly swings open, followed by a vortex of water that sucks the prey inside. Instantly the door snaps back into its original position, securely sealing the chamber. For the hapless individual, escape is impossible; digestion inevitable. With the entire process over in a fleeting 1/240 of a second, there is little time for building suspense. A varied assortment of organisms are subject to

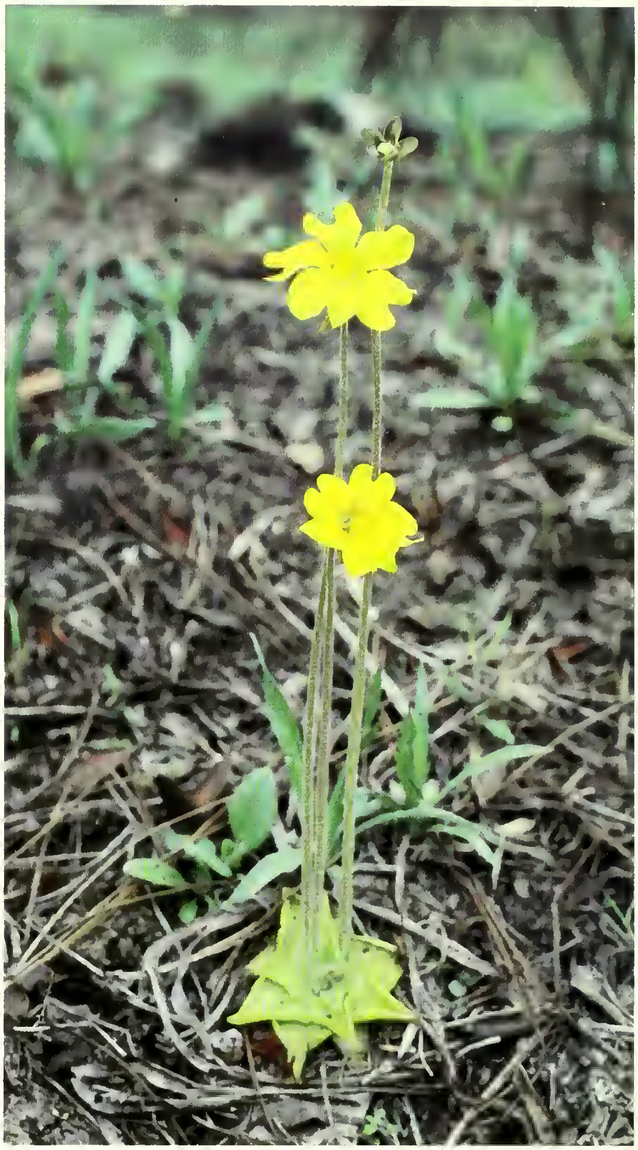


(Opposite page) Of elegant design and efficient performance, the leaves of the purple pitcher plant, Sarracenia purpurea, *are perfect pitfall traps. (This page, top photo) Allured by the sundew's tentacles, these tiny insects will soon serve as food for* Drosera filiformis. *(Lower left) The purple bladderwort,* Utricularua purpurea. *(Below) The red pitcher plant,* Sarracenia rubra, *is often found growing with its larger relative,* Sarracenia leucophylla.





A common occupant of moist, sandy soil, the yellow butterwort, Pinquicula lueta, *is frequently encountered in pine woods and savannas.*



predation. Protozoans, crustaceans, mosquito larvae, worms and even small tadpoles are ingested. Some authorities have suggested the use of bladderworts in mosquito control. The notion seems less absurd considering that a stand of the plants occupying 100 yards of shoreline is capable of netting over 1.4 million mosquito larvae.

Among the showiest components of our coastal bags, pitcher plants depict a bit of pretentious evolution. Both pitchers and flowers appear to be more of a surrealistic accomplishment than a natural one. In certain areas where habitat is optimum, pitcher plants form dense stands, sometimes covering several acres. In full bloom such bogs create an awesome display of gregarious splendor, rivaled perhaps only by the tulip fields of Holland.

Although the flowers are distinguishable mainly by color, the leaves or pitchers come in a vast array of shapes and sizes. Some are trumpet-shaped, others urn-shaped; some stand over three feet tall, while less conspicuous forms lie prostrate. Why all the variability? Each species specializes in capturing a certain group of insects; therefore pitcher design varies to accommodate the prey each plant prefers. This phenomenon, known as resource partitioning, enables many species to coexist by reducing competition.

The pitcher is a unique evolutionary innovation. With a digestive soup filling the base of the shaft, these tubular reservoirs are perfect pitfall traps. Enticed by a nectar source, an unsuspecting bug alights on the pitcher's rim. Once entering the pitcher, the insect soon finds itself in a precarious situation. Recurved bristles coerce descent. Waxy substances cling to the insect's wings and feet. As the tunnel narrows, frenzied attempts to escape serve to weaken the victim. Fatigued and bedraggled, the insect finally succumbs to the acrid liquor below. Prodigious numbers of insects contribute to the plants' lengthy repast over summer months. Having served their purpose, the weathered pitchers of most species die off in late autumn. Underground rhizomes will send forth new pitchers the following spring, starting the cycle all over again.

Any biology student with a conscience could not write about these remarkable wildflowers without inserting a brief plea for their welfare. Carnivorous plant habitat has been steadily declining over recent years. Though many species are still quite common, others are not faring so well. Stream channelization, farm pond construction, excessive fire control, not to mention commercial collection, have all contributed to the degradation of carnivorous plant habitat. Fortunately there has been a growing concern over the plight of these and other wildflowers throughout the state. Under the Wildflower Preservation Act of 1973, six species of pitcher plants have been designated as "protected species". Such environmental awakening is encouraging, not only for Georgia's native flora but for all of our state's natural heritage.

The next time you visit a portion of south Georgia, keep a close watch for these botanical carnivores along roadside ditches and savannas. Be careful though: they're apt to capture your interest as easily as they catch bugs in the bog. ●

Stalking the Backyard Bear

Sometimes you get the bears, sometimes the bears get you.

By Kent Kammermeyer
Wildlife Biologist

It all started back in April of 1977. I had just begun as a wildlife biologist with the Georgia Game and Fish Division when the wildlife nuisance complaints started rolling in from all angles. First it was deer eating gardens. Then came muskrat and beaver damage in farm ponds. And finally the ultimate — bears.

Bears, it seems, have a habit of getting into all sorts of trouble in the springtime — raiding bee hives, garbage cans, or camping areas, or maybe just loafing around in town on a Saturday night looking for action. David Carlock, the experienced bear research biologist in Gainesville, had warned me about the bear-catching business, but being a rookie biologist, of course, I had to learn for myself.

Our first big assignment came in a moment's notice (as they all do). We happened to be in Atlanta working at Georgia Tech on some sort of computer analysis. We snuck out of there to get some lunch (our first mistake). Our state band truck radio was blaring continuous conversation about a bear in Marietta. Our Atlanta office was looking for the nearest wildlife biologist with a dart gun. Well, David and I were both biologists and we did have a dart gun. So, forgetting the old army principle of never volunteering for anything, we found ourselves quickly on the way to the scene of the crime, discussing the pros and cons of volunteering (our second mistake). We arrived at a subdivision near Sprayberry School and the scene was disturbing. Three television camera crews were there from Channels 2, 5, and 11, neighborhood kids were running everywhere and police cruisers were constantly circling the block. When we came to a stop the newsmen assaulted our Game and Fish truck asking where the bear was. Since they had been there longer than we had, we thought that question was out of line. David whispered over to me to be prepared for a long, dull afternoon since real bears rarely show up at bear complaints. We loaded two doses of drug anyway just to look prepared. We had just finished all preparations when a voice shouted, "There he is!" Sure enough, loping across a vacant lot toward us was our bear, a real one. David grabbed the dart gun and won a foot race with the camera crews over to the bear, who also got in the race. Meanwhile, I frantically loaded another dart with drug. The shot went off from David's gun. I ran over to him with a fresh dart. He was just picking up his discharged dart. We opened it and could tell it had made a good clean hit, injecting all of the drug.

Joe Hamilton

We held off camera crews for nearly 10 minutes, allowing the drug to take effect. Then the search began; I went one way and David the other. We met halfway between that small patch of woods and still had not found the bear. We began scouring the edge of a small pond, when David found him and called me over. The bear was lying in the mud with his nose partly under water and bubbles rising from his nostrils. Another inch or two and he would have drowned! We quickly lifted his head and checked his vital signs — they were ok. Meanwhile, the camera crews were tiptoeing through the mud and water and brush to get a closeup. After obliging the press, we lifted the 100-pound bear and carried him to our truck. One more picture and interview session, and we loaded the groggy, drugged bear in the truck and headed for Gainesville.

As usual, we got stuck in traffic around Canton and the drug began wearing off. The bear had sat up and was looking over the back of our tailgate contemplating escape. We stopped, ran back there and injected another syringe full of tranquilizer. All we had to do was get to Gainesville where a bear cage was waiting. We took all of our information from the bear — weight, measurements, age, sex and gave him a pair of ear tags for identification and a radio collar to track his movements. After releasing him in the remote mountains, the reality of the event hit us. We had captured a bear with a dart gun, nothing went wrong, and all of it in front of TV cameras. Old Marlin Perkins (of "Wild Kingdom" fame) himself could not have done any better.

Carlock and I talked about the amazing capture and came up with a list of items which make it virtually impossible to catch a bear the way we did. We call them the Principles of Bear Catching.

1. As mentioned previously, bears seldom show up at bear complaints. Even if it is a real bear, he is rarely seen.
2. A crowd of people, always at bear complaints, tend to scare the bear away.
3. Bears are more easily captured when chased up a tree. However, bears very seldom will cooperate and actually go up a tree.
4. We have to get within 30 yards range of the dart gun with a clear, unobstructed shot. Bears prefer thickets and will run the other way on sight of a human.

Aaron Pass

Bear researchers at work. David Carlock, above, investigates an active den tree containing a young sow and at least one cub. Kent Kammermeyer, below, prepares to tranquilize a trapped bear so it can be removed and examined.

David Carlock

5. We have to hit the bear in the heavy muscle of the hindquarter to prevent injury and overdosing of drug.
6. We have to load the proper dosage of drug for the body weight of the bear.
7. The powder charge in the dart has to go off on impact.
8. And, finally, we have to find the drugged bear after he's shot. Sometimes, we can narrow it down to one or two acres of woods, if we're lucky.
9. For all of the above to work, we have to be extremely lucky. More often than not, one of these principles fails and that's the end of the bear capture. Murphy's Law, often applies to bear capture operations: Everything that can go wrong will go wrong.

Leonard Lee Rue III

In 1977, things slowed down after the Marietta bear. But by mid-1978, we were beginning to wonder if things would ever slow down again. Our first incident of that year, in May, was typical. David and I were sitting in the Health Clinic in Atlanta for our annual checkups. We should have remembered that every time we go to Atlanta something goes wrong. Our secretary called and told us that a bear had shown up in downtown Gainesville. Frantic calls were reporting bear sightings by motorists, homeowners, shoppers and police. Well, we couldn't do much good 60 miles away. We got to Gainesville as quickly as we could, gathered up dart guns and began bear hunting. There were at least six Game and Fish units at the scene when we arrived. They quickly said goodbye and deserted us. The police left, the animal control unit left, and even the newspaper reporters left. The only thing we could do was stay in the area and wait for sightings. We raced from one bear sighting to another all afternoon, always getting there a little too late. We did see the bear four or five times but never got close enough for a shot. After six hours of futile effort, we arrived at another complaint and ran into the woods with our dart guns, police following. David spotted the bear sitting in a small thicket looking confused and tired. We eased around looking for an opening through the tangled vines.

Through the scope of the dart gun, I picked out a small opening in the tangled brush and threaded a dart through to the bear's front shoulder for a solid hit. The bear ran a few yards and stopped within 10 yards of David. The police officers then came crashing through the woods with guns drawn. The bear made a beeline for the thickets, as fast as he could go. We lost our easy capture and knew it would take time to find him now. That thicket was one of the worst I've seen — honeysuckle, kudzu, privet, briars and all.

After 10 minutes of waiting, we spread out and started into the thicket. A squeaky little voice yelled out from the other side of the thicket, "Here he is!"

"What?" we replied.

"The bear, he's over here."

We crawled through the thicket as quickly as we could and found a group of young boys standing in the open woods and the bear leaning against a tree 20 yards away weaving his head back and forth. He had run about 300 yards through the thicket, had come out the other side and collapsed near the excited audience.

Now anyone who knows little boys knows they are always into something they're not supposed to be into — this time it was capturing bears. But we sure were glad they helped us find him. I often wonder what they told their mammas that night about the experience!

Anyway, the bear was already showing signs of recovering from the drug. We got him to the truck just in time to give him another injection as he was rolling around on the ground wrestling with two biologists. The gathering crowd took it lightly, though, asking each other if that really was a bear.

Well, we ended that episode with another trip to the mountains after tagging, weighing and measuring again.

By now the bears were really bent on giving us trouble. Three days later, I was on my way to check a complaint in a Forsyth County campground on Lake Lanier. I got there only 30 minutes after deputies had sighted the young trash can marauder. David Belcher, a biologist, was nearby on another complaint, and he came in to assist me. First inspection of the area revealed about 10 smelly garbage cans turned over in the campground. Two young boys approached us and nonchalantly stated that they followed the bear and got within about 10 yards of him. Then they offered, "We have a fish, you want to use it?"

"For what?" I said.

"You know, for bait to catch that bear."

"You've got to be kidding," I said, "That won't work."

David and I, along with a Forsyth County deputy walked into the woods with our dart guns. About 45 minutes later, we arrived back at the campgrounds, hot, tired and empty handed. "I'll take that fish now," I cautiously said to the boys. They brought us a 1½ lb. bass. We built a small fire, thoroughly burned the fish and hung it up on a tree limb near the campground. We sat on a picnic table thinking about the futility of the situation and fully believing we were in for an extra long bear hunt. Less than 10 minutes passed when we heard a scuffling in the leaves. We looked over in the woods and David and I looked back at each other simultaneously blurting "squirrel." We heard it again. We heard it a third time and saw a patch of scraggly black hair. "It's a bear," I said in a hoarse whisper. We slid off the table and got in position for a shot. We could see the bear now, slowly approaching the fish with his nose in the air. But he was actually too close for a shot — less than 15 yards away from us. I tried anyway and my high arching dart apparently went over his back. Unsure of a hit, I motioned for David to shoot; his dart hit the bear high and flipped over, spraying drug in all directions.

Well, we really had trouble now not really knowing if either dart had injected any drug. This wild bear was amazing, though. He took the excitement all in stride, walked over and sat down in a honeysuckle patch less than 10 yards from that smelly fish. We stood there in plain view, wondering what to do next. Common sense told us we had to wait. We stood there dead still for 10 minutes watching for the drug to take effect. No reaction. The bear was still sitting there, looking around wondering how to get that fish out of the tree! I raised my gun and shot again — this time it was a solid hit in the shoulder and the bear ran off. We were able to keep him in view and he keeled over after five minutes. We carried him to the truck, loaded him and headed

At left, a sub-adult bear is measured. This age class contributed most of the suburban wanderers. (Below left) This lip tattoo will identify this bear if it is ever re-trapped or killed. (Below) Still heavily under drug, this young bear displays its identifying ear tag which matches its tattoo.

for Gainesville. Amazing! We had gotten away with two mistakes and still came out looking like Marlin Perkins. This bear also went to the mountains where he probably came from in the first place. We were running out of wild places to put these mischievious rascals.

Less than a week later, we captured bears number three and four in the same night.

David Carlock used a trap to catch one that was raiding beehives in Franklin County. My catch was a bear at Big Canoe resort area which was getting into cabins. It seems two of them had teamed up to crawl through a window on the porch, climb down into the kitchen and grab a bunch of ripe bananas lying on the kitchen table. They did make a tour of the house before they left, eating sugar, coffee and other edibles, tipping over chairs and tearing up pillows. We knew we were after real bears when we got there because there were two distinct muddy bear tracks on the interior of the kitchen wall where they had climbed through the window. The homeowners were deciding whether to leave them as souvenirs or wash them off.

Anyway we did catch one of these bears in a trap (after two weeks of baiting). It was a diminutive 82 pound male yearling.

This pair of catches made four bears caught in a two week period in our own region alone, plus one captured further south in Cobb County. The ironic part about it was that we had been baiting and trapping bears for research purposes on a prime mountain location in the heart of bear country for nearly two months without catching a single animal.

There has been a definite pattern to these nuisance bear complaints this year and in previous years. We are almost exclusively dealing with young yearling male bears who have wandered far from their normal range in search of living quarters. These wandering yearlings are common since their mothers, after denning with the yearlings through their second winter, wake up in the spring ready to breed again. Bears breed every other year so the older (1+) cubs are forced to leave when mamma bear mates and begins preparation for a new litter to be born again the following winter. In the spring, then, it is apparent that neither the mother bear nor the adult male who seeks to breed her will tolerate cubs in the vicinity. This sends yearling cubs in search of new territory. Many males seem to go south and end up in trouble wherever there are enough people and cars and cities to get tangled up with. Weights of the yearlings we have captured this year range from 82 to 120 pounds — typical for this age animal. Ages are determined for certain by micro-

Keeping track of bears. This bear sports a radio collar which will allow researchers to check its location. (Above) Carlock and technician Al Crews try to locate a collared bear. By understanding their ranging habits, we can more intelligently manage bears and protect their habitat.

scopically examining a section of tooth and counting the growth rings which are similar to those that occur on a tree.

In spring of 1978 we were spoiled by success. Catching four bears in quick succession is a feat not to be taken lightly. Things usually manage to even out in the end though. Some of our later complaints were quite frustrating. I answered one in Hall County which was typical of the later complaints. About nine o'clock on a Friday night in June, I received a phone call that told the story of a 30 pound bear cub which had been chased up a tree by dogs near a house on Lake Lanier. For the entire 45 minutes it took me to get there, I was worrying about the whereabouts of mamma bear and wondering what she would do to me or anybody else who threatened her cub. After all, what self-respecting mamma would abandon such a small, helpless cub?

When I arrived at the scene, there were two deputies, three firemen and about a dozen local residents shuffling around nervously in a small patch of woods. I was met by a deputy who led me to the tree, a tall spindly pine. He shined his light up the trunk and said, "There he is!" I grabbed the light and heaved a sigh of relief at the same time. There, 20 feet up that skinny pine tree, was a small, thoroughly frightened groundhog! The 8-pound animal was clinging to the bark and glancing to the ground wondering what all the excitement was about. After I convinced all the bystanders that it really was a groundhog, arguments and apologies broke out all at once. Nobody would really admit they thought it was a bear — blaming it on everybody else. I found it to be quite amusing that out of all those people, deputies and firemen, that nobody could figure out the difference between a bear and a groundhog.

After that, Carlock and I investigated about 10 more bear complaints where we did not see a track or bear or groundhog or anything. We have started to selectively choose which complaints are worth visiting and only visit worthwhile complaints where damage or injury to bears is a potential. This bear capturing business is touchy at best! ●

CROP DAMAGE & DEER

Georgia's most popular big game animal is also an agricultural pest.

By Daniel K. Grahl, Jr.
Wildlife Biologist

Complaints about deer damage to gardens and agricultural crops have increased significantly over the past few years. This does not necessarily mean high deer populations since one or two deer are capable of doing more damage than most people care to tolerate. Damage caused by just a few hungry deer will prompt complaints from Farmer Smith whose 600 acres of soybeans are being destroyed, or John Doe whose one acre garden is being invaded.

Deer feed on many different species of plants and are especially fond of those grown under fertile conditions. Damage can be in many forms such as: nipping off the terminal buds of trees (called browsing) which stunts growth; knocking fruit off trees; trampling down plants as they travel through; and eating garden and field crops. In early fall, bucks can do considerable damage to small trees by rubbing them with their antlers. In Georgia, the major crops affected are soybeans, peanuts, watermelons, peach and apple orchards, and home gardens.

Since damage can take so many different forms and occurs over such widespread areas, it is difficult to recommend repellents or other control measures which work every time. If deer populations are high, there is no inexpensive or simple solution to the problem. In most cases, long-range planning and management of the herd are required. The following methods can be helpful to landowners suffering from deer damage.

Population Control

The most practical method of controlling deer damage to crops is to keep the herd in check. This can best be achieved through legal hunting during the regular deer hunting season. Many hours of enjoyable recreation can be provided for the hunter and if the landowner rents the hunting rights to his land, he can receive some extra money to help compensate for any loss due to damage. Hunting alone will not necessarily solve the problem. In many cases, large tracts of land are posted which means they receive little or no hunting at all. The "protected deer" will then move off this land to adjacent land and continue to cause damage. Allowing hunters to come on your land and take the surplus animals may not solve the problem entirely, but it can reduce the amount of damage occurring. It can be especially helpful if the hunters will cooperate and remove doe deer during those days set aside as legal either-sex days. The only effective way to reduce a deer herd through legal hunting is by removing the doe deer.

In May of 1976, the Game Management Section of the Game and Fish Division was authorized to issue permits for the purpose of controlling deer doing damage to agricultural crops. This authorization was for those crops which would be marketed. These permits allowed the landowner to shoot a specified number of deer and could even specify the number of bucks and does to be taken.

A recent study of crop damage by deer in the Southeast by biologists W. Gerald Moore and Robert H. Folk III of South Carolina's Division of Wildlife and Freshwater Fisheries showed that 12 of 15 southeastern states utilize a permit system for controlling deer damage. Although this method is used frequently, there are many disadvantages which must be considered. It requires many man-hours of time for each deer that is killed. It is often inefficient because other deer move into the area to take the place of those shot. Many times it generates bad feelings with the local sportsmen who feel they are being deprived of the opportunity to utilize the surplus deer for hunting. Therefore, the best method for reducing the deer herd and, in turn, reduce the damage caused by deer is allowing access by legal hunters to remove the surplus animals.

It is often necessary to keep nuisance deer away from crops and gardens although the herd has been reduced. This is generally achieved by using one or a combination of the following: (1) repellents, (2) frightening devices, and (3) fences.

Repellents

In the past, most of the repellents kept deer away because of their odor. Probably the most commonly used odor repellent in Georgia is one manufactured under the brand name Magic Circle Deer Repellent. This is virtually a pure concentration of bone tar oil (liquid produced by the process of dry distillation of bone which has a pungent odor). There are two methods of applying this repellent for protecting crops. One is most adapted to gardens and small fields. It requires the erection of stakes (fence posts will substitute), with burlap or other suitable material wrapped around the top of the stakes, spaced approximately 15 to 20 feet apart. The burlap is then soaked in the solution and usually requires another soaking in 10 to 14 days. Many landowners have used this repellent with little success. In most cases, the failure of this repellent to work has been due to the late application. To obtain better success requires that the repellent be applied **before** the deer start eating the crop. Once feeding has commenced, it is difficult to keep deer from continuing with an odor repellent.

The other method of application is to mix the repellent in a spray tank and spray a band six feet wide around the entire field. This is usually applied to other vegetation growing adjacent to the field. Experiments have been conducted with other odor repellents such as human hair (obtained from barber shops), insecticides and even lion dung. Some of these have been successful in keeping deer away from crops.

Experiments are presently being conducted on several taste repellents. Unfortunately, most of the taste repellents are limited to fruit trees. In one study that has just been completed by Game Management biologists, chemicals containing the compound Thiram were tested on apple and peach trees. The two chemicals used were Tat-Go and Arasan 42-S. Tat-Go is no longer available and Arasan 42-S is manufactured by Dupont in a limited amount. The results showed a very significant protective effect for the first three years.

Frightening Devices

Frightening devices which have been used and proved successful range from tying dogs up around fields to the sophisticated carbide guns. The general rule of thumb concerning frightening devices is to let your imagination be your guide. The best results have been obtained by using several different types and changing them every couple of weeks. This is necessary because after a short period of time, the deer realize they are in no danger and will start damaging crops again.

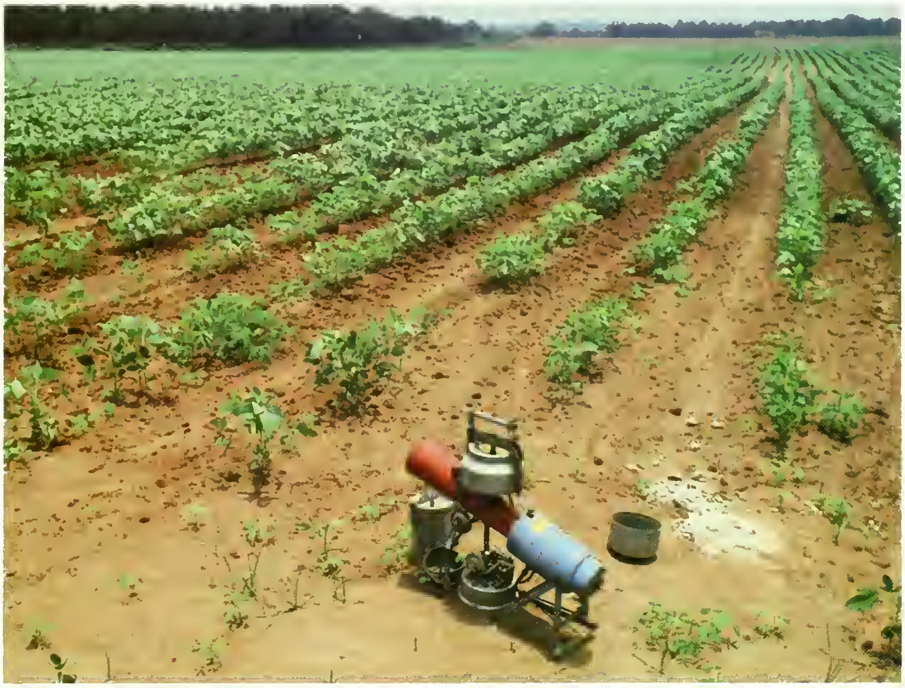
Some of the other methods tried include placing kerosene lanterns around the field on top of barrels, placing portable radios around the field with the volume turned up, and tying aluminum pie plates from overhanging tree limbs so that they beat against one another when the wind blows. As mentioned previously, let your imagination be your guide.

Fences

Fences can be the most effective means of controlling damage, but they can be expensive over a short period. However, if properly constructed they can last for up to 15 years, which reduces the cost significantly. Fencing is generally limited to one of two types: overhanging and electric.

The over-hanging fence can be constructed by using six-foot poultry netting with 2-inch mesh, having one edge fastened to the ground with stakes and extending upward at an angle of approximately 50 degrees. It is sloped away from the crop to be protected. As deer approach the fence, they walk under it along the edge and seem unable to jump over.

Electric fences have been successful in repelling deer from a 40-acre watermelon field. In other cases, a single strand proved ineffective. The most effective electric fence is one used in an experiment in South Carolina by biologist W. Gerald Moore. It is called a modified Vermont-type electric fence. This fence is an outrigger type, consisting of six smooth, heavy gauge, galvanized wires. Three of the wires are charged and the other three serve as grounds. The fence is five feet in height with an outrigger two and one-half feet from ground level and situated two feet



Ken Grahl

This carbide "cannon" fires explosive blasts activated by a self-timer. It works until the animals find that it is harmless.

Bill Bryant

Although soybean damage is the best known of deer depredations, other crops, orchards and home gardens are also affected by deer damage. This watermelon has been ruined by one kick and nibble.

outside the main portion of the fence. Each of the live wires is charged by a separate fence charger. This permits higher voltage and a stronger shock. A fence like this was constructed around one-half of a 4.5 acre soybean field in an area having an estimated deer population of one deer per 10 to 15 acres. The unfenced portion of the field was totally destroyed 13 days after planting; however, the fenced portion received no deer damage at all. Construction of a modified Vermont-type fence around a rectangularly shaped 50-acre field with a length twice that of its width was projected to be $42.58 per acre. The cost without posts would be $26.30 per acre. As the size of the field increases, the cost per acre decreases. If the initial cost of constructing this fence were prorated over the entire serviceable time (up to 15 years), the cost probably would not be prohibitive and might even be economical considering the increased profit margin obtained from stopping the loss due to deer damage.

Summary

The most efficient means of controlling deer damage to crops is through allowing legal hunters access to remove surplus deer. This is best accomplished by concentrating on removing doe deer on legal either-sex days. Permits are authorized for severe crop damage problems but often require high man hours for each deer taken. By renting the hunting rights to hunters, landowners can receive additional income which, in most cases, will offset any loss due to deer damage. Repellents can be used effectively if application is made before deer begin damaging crops. Frightening devices can be effective if several different types are used. By changing every couple of weeks, these different types seem to be more effective. Fencing is the most efficient, but initial cost of construction may seem to be prohibitive. However, if these initial costs are prorated over a serviceable period (at least 15 years) the fences are no longer prohibitive and may even be economical.

By contacting your local Game Management Office of the Game and Fish Division, technical assistance in controlling deer crop damage can be obtained. Wildlife biologists and technicians are available to explain the techniques found to be most effective in the different areas of the state. Remember that for repellents or frightening devices to be most effective requires that they be applied before the damage starts occurring. ●

focus:

Georgia's Protected Species

Kirtland's Warbler

By Mary Anne Neville-Young
Biologist, Game & Fish Division

In the forests of northern Michigan, the endangered Kirtland's warbler is slowly returning from the road to extinction. This apparent comeback is due largely to a belated understanding of the unique needs of this tiny songbird. Appropriately called "Michigan's Bird of Fire," the Kirtland's warbler cannot survive unless its breeding grounds are burned. The case of the Kirtland's warbler, like that of so many other endangered species, reflects the vulnerability of a creature which is highly specialized.

The scientific name for the Kirtland's warbler is *Dendroica kirtlandii;* it belongs to the warbler family Parulidae. Members of this taxonomic group are small, colorful, insectivorous songbirds. Fifty-four species of warbler occur in North America.

Like many warblers the Kirtland's exhibits sexual dimorphism: that is, the male and female birds differ in appearance. Apparently nature has devised it so that the least conspicuous bird, the female, stays with the nest. The showy male is characterized by yellow underparts, with black streakings along the breast and flank, a bluish-grey back also with some streaking, white undertail feathers, a black face mask, and a black bill. The female lacks the face mask and generally appears more uniform in color. Immature birds and fall warblers (birds which have molted their breeding plumage) appear mostly grey in color.

The song of the warbler is wren-like in character. It consists of loud, low-pitched bubbling notes. In true warbler tradition, the Kirtland's is very active and constantly flits about, rarely staying in one spot. It also continuously bobs its tail, a trait which helps distinguish it from other warblers in the field.

Kirtland's warblers are ground nesters using fine grasses to construct their nests built near the base of

The Kirtland's warbler's endangered status is primarily a result of specialized habitat requirements. These birds, with breeding ground in north central Michigan, require young jack pine stands, 80 acres or larger in size. To maintain pine ecosystems like this, fire is necessary because the cones of mature jack pines will not open to release their seeds except under intense heat. (Illustrations by Mary Anne Neville-Young.)

young jack pine trees. The lower limbs of the tree conceal the nest, which may contain four to five very pale yellow or pink eggs with brown blotches. The eggs incubate in about two weeks. The male bird feeds the female during the incubation period.

The breeding range of the bird is limited to small areas of upper Michigan. Wintering areas are in the Bahama Islands. Consequently, the bird's migration route occasionally includes Georgia's Atlantic coast. Because the Kirtland's warbler is a federally protected species which is transient in our state, it also receives statutory protection in Georgia even though the last documented sighting was early in the century.

Why is the survival of the Kirtland's warbler uncertain? The most significant factor involves the breeding part of the bird's life history. In 1903 the exact breeding ground for the species was discovered in north central Michigan. It was determined that the birds require young jack pines in stands of 80 acres or more for nesting. To add to this already specialized requirement, the bird seems to prefer only jack pine stands growing on "grayling sand," a particular type of porous soil. These jack pine communities represent an intermediate stage in ecological succession. To maintain this pine ecosystem, fire is necessary because the cones of mature jack pines will not open to release their seeds except under intense heat. Since fires have been generally prevented rather than encouraged in areas otherwise suitable for jack pine stands, the reduction of breeding habitat has contributed heavily to the decline of the warbler.

In addition, the pine forests in the Bahamas, which constitute the bird's wintering sites, have been heavily logged. Thus the warbler quietly lost habitat in the most vital portions of its range: the place where it breeds and the place to which it is biologically programmed to migrate for the winter.

Another problem which faces the Kirtland's warblers which do nest successfully is the brown-headed cowbird. This member of the blackbird family is the only brood parasite in North America. After throwing out the eggs which actually belong in the nest, the cowbird lays its own eggs in their place. Cowbirds regularly parasitize several warbler species, the endangered Kirtland's included. In this way, Kirtland's warblers become unknowing foster parents to one or more young cowbirds, drastically decreasing their own reproductive successes.

To aid in the recovery of the warbler, state and federal agencies are removing cowbirds from Kirtland's warbler breeding habitats. In addition, controlled burning is being carried out in potential nesting areas to ensure ample stands of young jack pine. To promote the maintenance of proper habitat and protection on the bird's wintering grounds, the U. S. Fish and Wildlife Service, along with the Minnesota Department of Natural Resources, is working in cooperation with the Bahamian government.

For the last few years, the U.S. Forest Service has conducted a breeding census for the Kirtland's warbler in Huron National Forest in Michigan. The census technique involves a counting of singing males. In 1976, reports indicated 200 breeding pairs. In 1977 the census showed 218 pairs, a small but welcomed increase. The 1978 census indicated 193 singing males. This decline from the previous year may be a result of habitat loss within the survey area. However, an interesting sidenote to the recent census was the observance of 2 singing males in Wisconsin and 2 singing males in Quebec. Although these birds were presumably unmated, their appearance in these areas may represent a pioneering effort in that portion of their historic range.

No numerical estimates exist for the Kirtland's warbler in Georgia since it is such a rare transient during migration. Perhaps, however, when the number of Kirtland's warblers increase, the birds will again be spotted in Georgia. Someday, perhaps, during spring or fall migration on the coast, a fortunate observer will sort through a flock of warblers with binoculars and discover a Kirtland's among them. This will be a time to look forward to.

focus:

Georgia's Protected Species

Lady's Slippers

By David Ettman
Photo by Leonard E. Foote

Two of Georgia's most striking native wildflowers, which are becoming increasingly scarce due to habitat destruction and indiscriminate collecting, are now protected under Georgia law.

They are the pink and yellow lady's slippers (*Cypripedium acaule* and C. *calceolus* var. *pubescens*), members of the orchid family, the most advanced in the plant kingdom. Other colloquial or common names for these species include moccasin flower and stemless lady's slipper for the pink, and golden slipper or nervine root for the yellow.

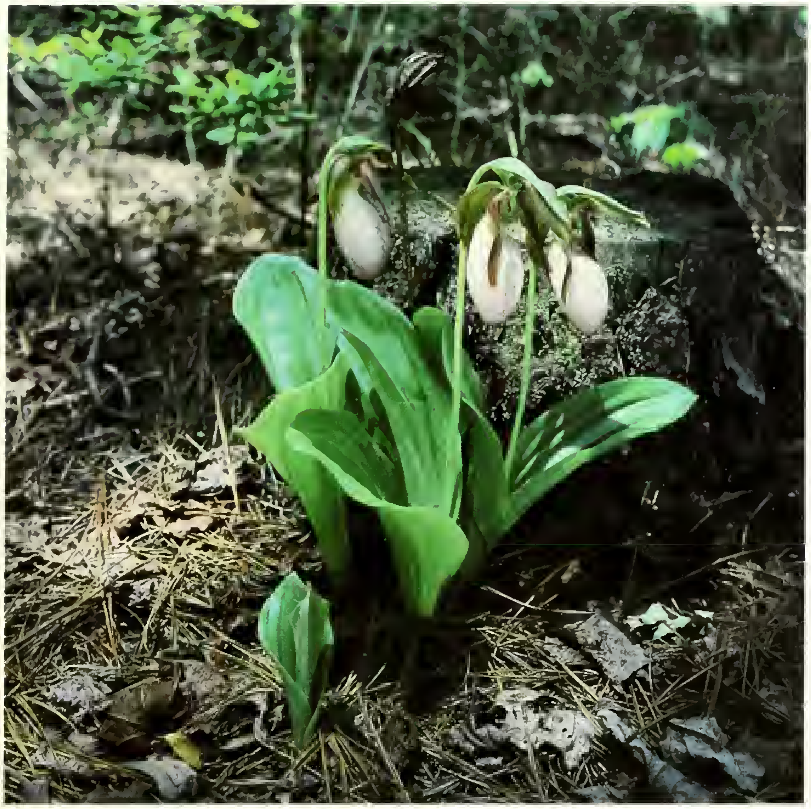
These alluring plants differ from their relatives in several ways. The most obvious difference is the presence of the swollen lip petal which resembles a little shoe or slipper, hence the common name, lady's slipper (*calceolus* actually means little shoe in Latin). The lady's slippers are thought to be a primitive group in the orchid family, growing as they do in soil rather than attached to trees like many orchids indigenous to the rain forests of Central and South America.

North Georgia provides one of the southernmost habitats for the lady's slippers, which occur as far north as Canada. In addition, a variety of yellow lady's slippers can be found in Europe and Asia. Dense colonies of the pink lady's slipper exist in scattered north Georgia locations while the yellow lady's slipper is less common.

The pink lady's slipper is typically found in pine woods which have a thick layer of needles covering the forest floor, while the yellow prefers rich, moist deciduous woods. In Georgia, the flowers normally open in early spring, however at high elevations they may bloom as late as July.

The two species are quite distinct in appearance. The pink lady's slipper has two downy basal leaves which lie flat on the ground, hence the origin of the colloquial name, stemless lady's slipper. The yellow lady's slipper has three to five leaves alternately arranged on the stem. The flowers of both species have two inconspicuous petals, and a third which is showy and modified into a labellum or shoe. The color of this conspicuous petal is the greatest distinction between the two species. The pink species varies from pale to deep pink and is often laced with red veins, while the other species is a rich lemon color with varying amounts of deep wine red spots on the upper portion of the petal. These vibrant colors help attract insects which are necessary for cross pollination in the lady's slippers.

Charles Darwin was one of the first to examine



Pink Lady's Slipper (Cypripedium acaule)

this pollination process. Darwin found that bees were attracted to the lady's slippers by a nectar-like substance secreted by the tiny hairs that line the inside of the lip petal. He also noted that once a bee entered the shoe or lip petal, it exited through a different opening, and always with pollen sticking to some part of its body. Upon closer examination, Darwin discovered that it was impossible for a bee to leave the flower the way it had entered because the edges of the lip petal were infolded preventing exit, in addition to the fact that the petal's inner walls were slippery. So how was the bee leaving?

It turned out that the only way for a bee to make its exit was to crawl out through two small openings at the other end of the flower. In so doing, the bee will inevitably brush up against a structure which bears the sticky pollen. The bee then goes on to the next lady's slipper carrying pollen obtained from the last flower. As the bee enters the next lady's slipper and goes out, pollen from the previous flower may brush off onto the stigma, thereby pollinating that flower.

Occasionally, one will find a lady's slipper flower that either has large holes in it or a large dead bee. A bee that is too large for the openings in the flower must tear its way out or be trapped forever.

Once the flower or lip petal is pollinated, a capsule develops which contains thousands of minute seeds. Late in the summer or early fall, the capsule matures and breaks open, scattering the tiny seeds into the wind.

These seeds are different from those of most other flowering plants because they are naked embryos. In other words, the seeds have no stored sugars to provide for the growth of the new plant. For germination to result, the seeds need to come in contact with a specific soil fungus which provides the nutrients which the seeds lack. Needless to say, only a very small percentage of these seeds ever germinate, and even fewer reach maturity.

It takes five to seven years for lady's slippers to mature and flower. During this time the roots of the plants enjoy a symbiotic relationship with soil fungi called mycorrhizae. Without them, the plants cannot grow.

The low success rate of lady's slippers reaching maturity and the other intricacies of their life history may be natural causes for their rarity. However, man's activities have contributed greatly to the decline of these interesting and beautiful plants.

One major factor in the scarsity of lady's slippers is their collection by commercial and amateur plant collectors. Collecting has caused the species to all but disappear in places where they were once plentiful. And the sad part about it is that the plants rarely survive transplanting. In addition, the root of the yellow lady's slipper has been collected for many years for its reported medicinal value as a nerve sedative. Other major factors which are contributing to the decline of the lady's slippers include clear cutting, reservoir construction, and other developments associated with urbanization.

The pressures of collection and habitat destruction need to be reduced if future generations are to admire the pink and yellow lady's slippers in their natural environments, rather than solely in botanical gardens. ●

The outstanding scientific discovery of the twentieth century is not television, or radio, but rather the complexity of the land organism. Only those who know most about it can appreciate how little is known about it. The last word in ignorance is the man who says of an animal or plant: 'What good is it?' If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.

—Aldo Leopold